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Intelligent feedforward: *increasing performance and extrapolation capabilities with iterative learning control*

Joost Bolder
www.dct.tue.nl/jbolder
Jurgen van Zundert
Tom Oomen
Sjirk Koekebakker
Maarten Steinbuch
Control Systems Technology

Background

To enhance the performance of motion systems, the development of intelligent control techniques that automatically optimize the performance *per system* is highly promising, [1,2].

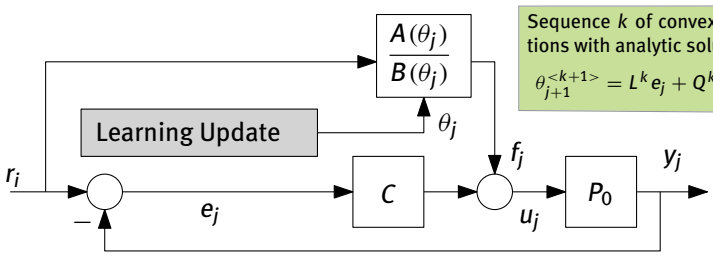
Many motion systems repeat *nearly* identical tasks and can benefit from intelligent control techniques such as Iterative Learning Control (ILC). A key assumption in ILC is that the task of the system is identical each repetition. As a consequence, the learned command signal is optimal for the specific task only.

This poster introduces rational basis functions in ILC. Such rational basis functions both increase performance and enhance the extrapolation properties of ILC.

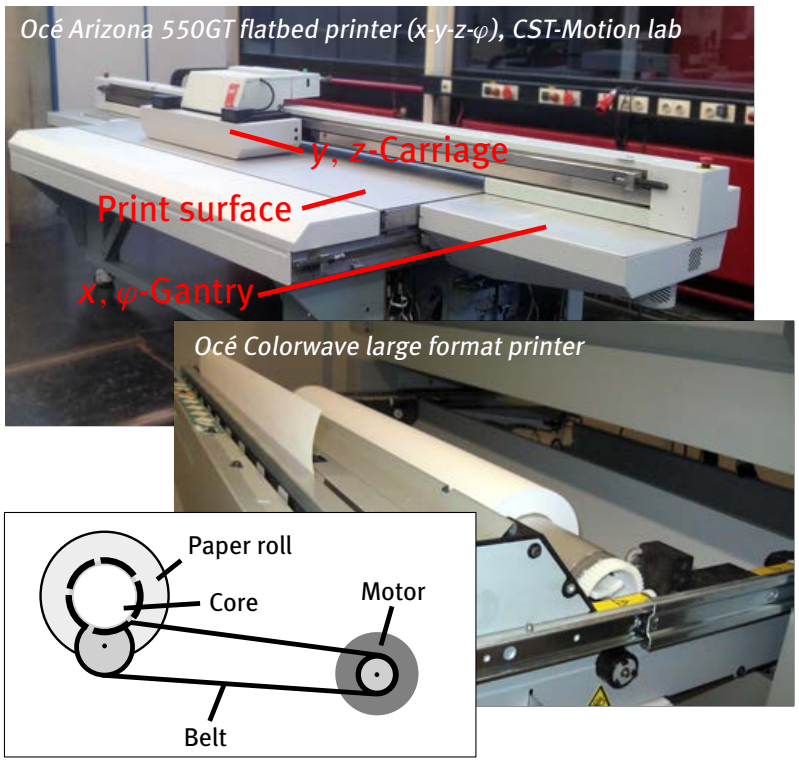
ILC with rational basis [1]

Key ideas:

- Parameterize command signal f_j in task r_i to introduce extrapolation capabilities
- Rational basis to compensate dynamics of both zeros and poles in system P_0
- Iterative procedure to update parameters θ_{j+1}



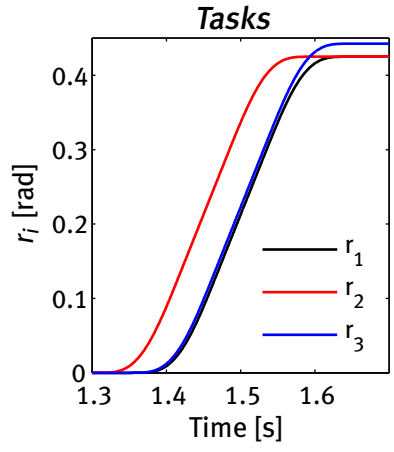
Applications

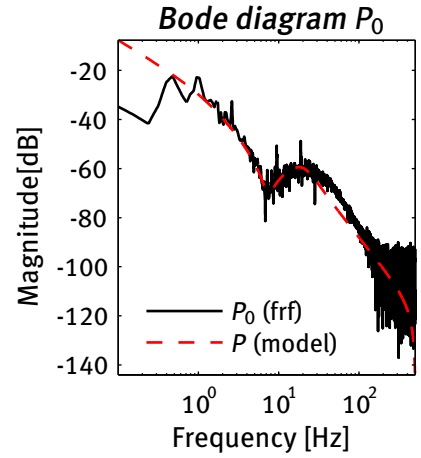


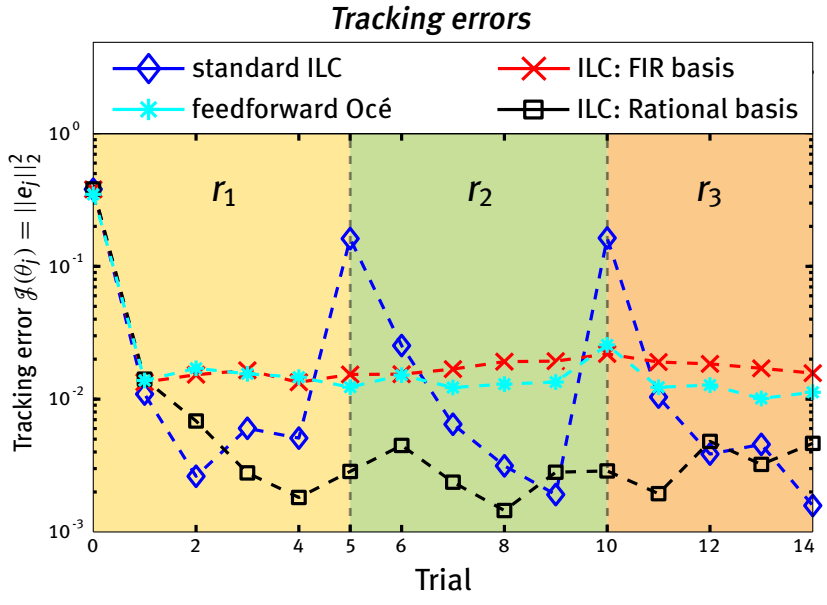
Experimental results [3]

The advantages of rational basis functions in ILC are confirmed in an experimental case study (large format printer):

- improved performance with respect to pre-existing methods
- excellent extrapolation capabilities for the on-line changes in task







References

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2. Frank Boeren, Dennis Bruijnen, Niels van Dijk, and Tom Oomen, *"Joint input shaping and feedforward for point-to-point motion: Automated tuning for an industrial nanopositioning system,"* IFAC Mechatronics, Invited paper, to appear.
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